Reports and Analysis Exercises

In these exercises you will:
1) Setup for Reports and Analysis
2) Create Summary Reports
3) Create Analysis Reports
3) Use the Analysis Reports to view species specific reports
4) Use the Confidence Intervals (CI) in lieu of One-sample t-tests
5) Stratify data using the UV fields on the Macroplot form

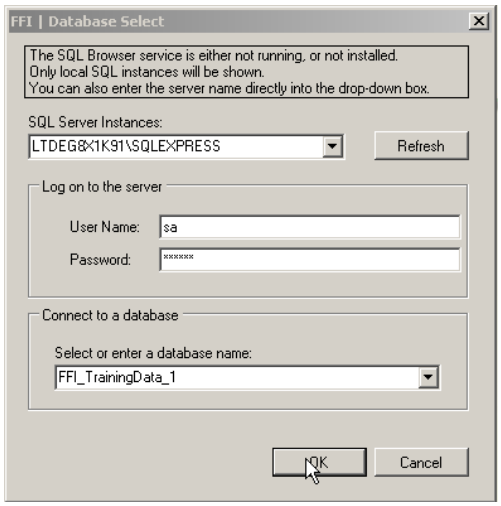
This exercise is designed to give you a brief overview of the summary reports and analysis reports in FFI. It isn't meant to be a complete description of the all reports and analysis available but to make you generally familiar with what's available.

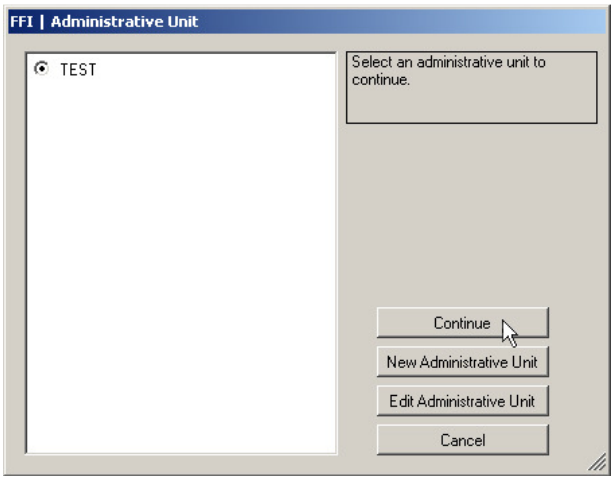
The Forest project in the *FFI_TrainingData_1* database includes data for six macroplots that have been measured three times:
2001/10/15 = Pretreatment measurements
2002/10/07 = First remeasurement (first year after prescribed fire)
2003/09/05 = Second remeasurement (second year after prescribed fire)

In this example exercise, assume a prescribed fire was applied to the site after the pretreatment data was collected then the macroplots were monitored again one year and two years posttreatment. Some goals of the fire where to: a) kill less than 10% of the total mature trees, b) increase live crown base height of the mature trees, c) reduce the biomass of fine woody debris (FWD), d) maintain the cover of beargrass (XETE) and e) maintain 11 tons/acre of duff.

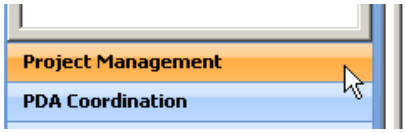
Exercise 1: Setup for Reports and Analysis

1.1 Open the database called *FFI_TrainingData_1* and select the *Test* Administration Unit.

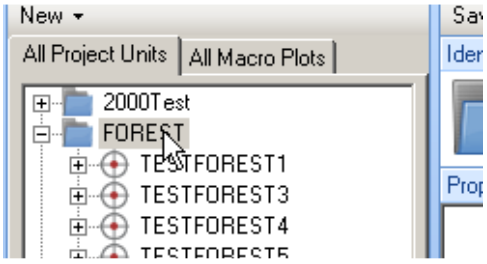




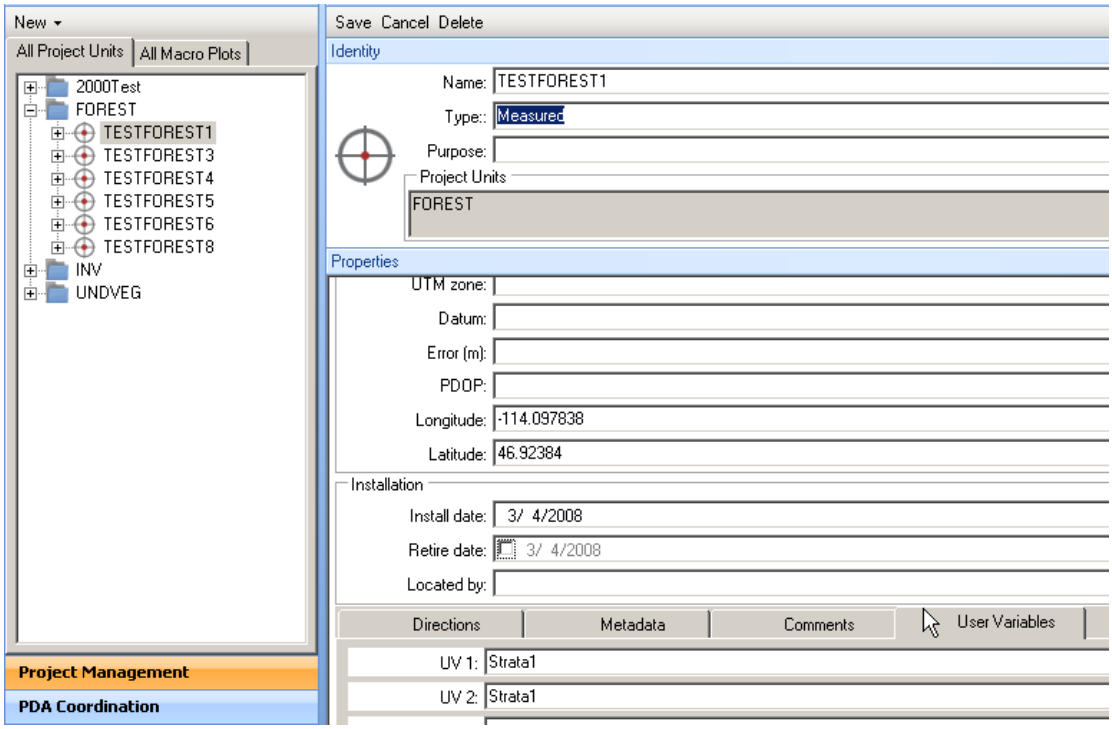
1.2 Click **Project Management** in the left pane.



1.3 Click on the *FOREST* project name in the left pane. Click the '+' sign next to the *FOREST* folder to make the Macroplot names visible.

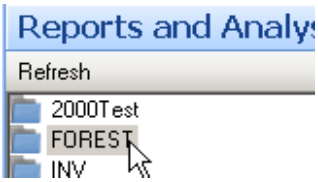


1.4 For each macroplot, click the macroplot name in the left pane, then scroll to the bottom on the right side and click on the **User Variables** tab. Make sure that it says Strata1 in the *UV2* field for each macroplot. You will use this UV field to put all macroplots into the same stratum (i.e. get an average for all macroplots for each sample event) when running the reports.

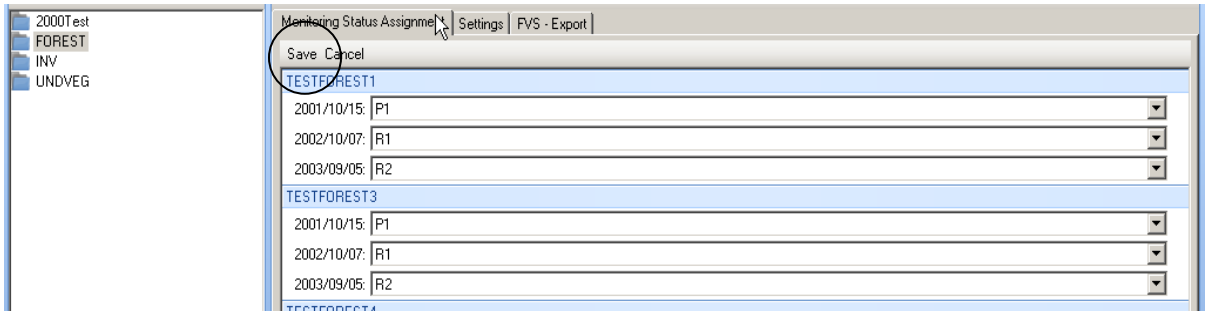


1.5 Click on **Reports and Analysis** in the left pane.

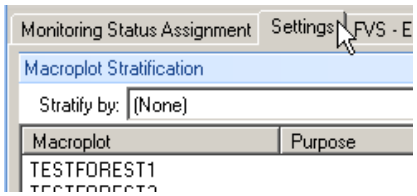
1.6 Click on the *FOREST* project folder in the left pane.



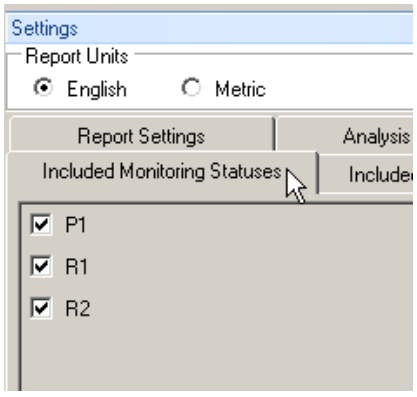
1.7 Click on the **Monitoring Status Assignment** tab and for each macroplot - if not already assigned - set the first sample event date to *PreTreatmentYear1*, the second to *ReMeasureYear1* and the third to *ReMeasureYear2*. Setting Monitoring Status identifies the sampling order for the analysis program. ***Click Save when done*** or you will have to reset all your monitoring status assignments next time you return to Reports and Analysis.



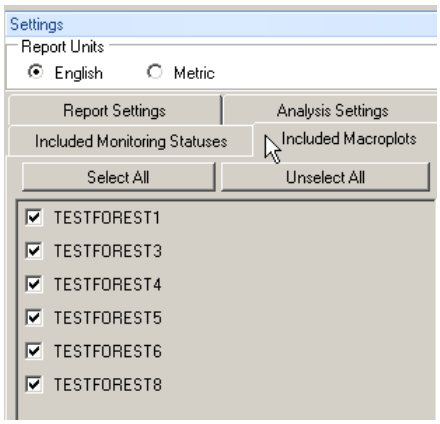
1.8 Click on the **Settings** tab and on the **Report Settings** tab on the right side, select *Trees***.**



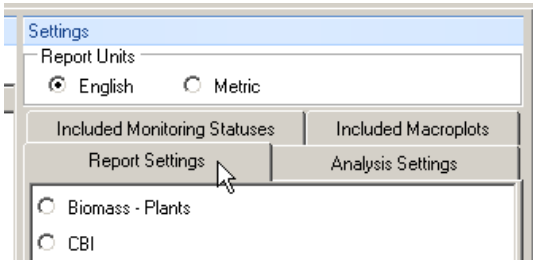
1.9 Click on the **Included Monitoring Statuses** tab and make sure all three are checked.



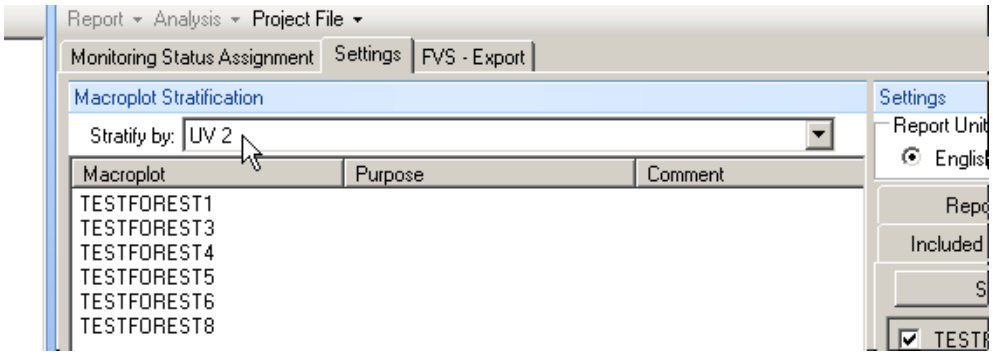
1.10 Click on the **Included Macroplots** tab and make sure all macroplots are selected.



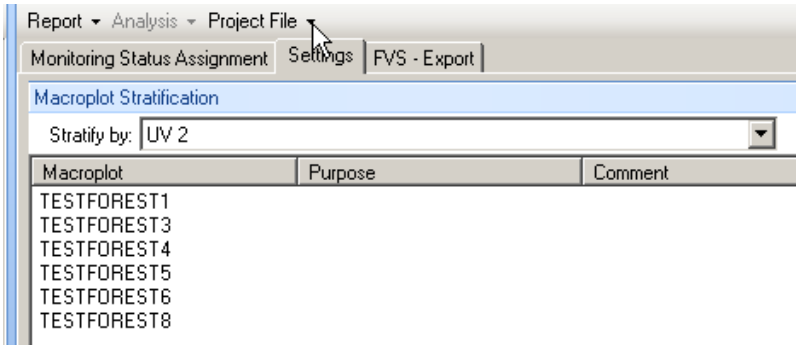
1.11 Click on the **Report Settings** tab. This tab must be selected to create a report.



1.12 In the **Stratify by** field select: *UV2*. This will group all the macroplots into one stratum for each monitoring status.



1.13 If you want to save all the settings you can **Export** the **Project File** at this time.

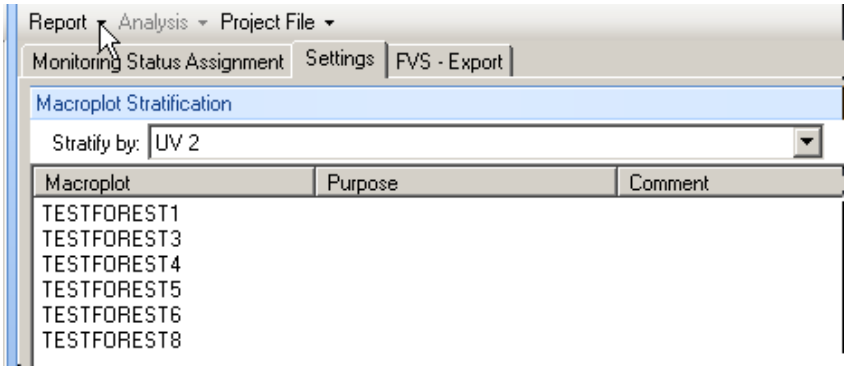


Exercise 2: Create Summary Reports

Tree Density

The summary reports in FFI present attribute values summarized to the macroplot level or by stratum. In this next example macroplots are summarized by *UV2* so the reports present average tree density by stratum.

2.1 At the top of the page click **Report** > **View Report** to see the tree summary report.



Trees Strata Summary

Strata	Monitoring Status	Trees (per acre)	Basal Area (sq. ft. / acre)	Avg. Live Crown Base Height (ft.)	Avg. Height (ft.)	QMD (in.)	Saplings (per acre)	Seedlings (per acre)	Total Trees (per acre)	Snags (per acre)
		Mature Trees								
Strata1	PreTreatmentYear1	48.5	39.2	27.0	64.8	11.8	58.5	625.0	523.7	10.0
Strata1	ReMeasurementYear1	33.4	34.5	36.9	71.7	13.2	58.5	625.0	508.6	23.5
Strata1	ReMeasurementYear2	28.4	32.1	36.9	74.2	13.8	58.5	625.0	503.6	28.5

Seedling and sapling density includes live and dead trees.

You will see on the left side that the data has been summarized to *Strata 1* for each monitoring status. That means all of the data on the six macroplots you selected in **1.10** have been grouped together and the values under each heading represent the average of all six macroplots in the stratum. Remember the Strata1 assignment was stored at the macroplot level (**1.4)**.

Look over the summary report and try to answer these questions:

Question 1: Did the treatment appear to be successful in the general goal of killing less than 10% of the total number of mature trees?

Question 2: Looking at this report can you tell how many seedlings the fire killed?

2.2 Click on the "X" in the upper right of the screen to **Close** the report.

2.3 If not already selected click on **Reports and Analysis** at the lower left of the screen, then the **Settings** tab at the top center of the screen. Click the **Report Settings** tab on the right side of the screen. Select the *Trees by Species* report, **Stratify by** *UV2* and click **Report > View Report** to see the next summary.

Trees by Species Strata Summary

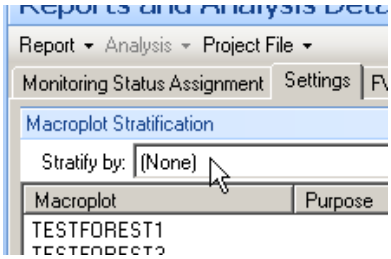
Strata	Monitoring Status	Species	Trees (per acre)	Basal Area (sq. ft. / acre)	Avg. Live Crown Base Height (ft.)	Avg. Height (ft.)	QMD (in)	Saplings (per acre)	Seedlings (per acre)	Total Trees (per acre)	Snags (per acre)
			Mature Trees								
Strata1	PreTreatmentYear1	LAOC	20.1	11.3	29.7	70.5	10.1	20.1	33.3	73.5	3.3
Strata1	PreTreatmentYear1	PICO	23.4	5.6	25.1	46.9	6.6	16.8	66.7	106.9	6.7
Strata1	PreTreatmentYear1	PIPO	20.1	30.7	26.7	76.9	16.5	17.6	125.0	162.6	2.5
Strata1	PreTreatmentYear1	PSME	16.0	12.3	21.5	52.2	9.3	34.1	340.0	390.1	4.0
Strata1	ReMeasurementYear1	LAOC	20.1	11.3	35.0	70.5	10.1	20.1	33.3	73.5	3.3
Strata1	ReMeasurementYear1	PICO	6.7	1.4	21.7	29.3	4.1	16.8	133.3	156.8	20.1
Strata1	ReMeasurementYear1	PIPO	17.6	32.7	32.3	83.8	18.0	17.6	125.0	160.1	5.0
Strata1	ReMeasurementYear1	PSME	10.0	7.6	26.8	39.2	7.1	34.1	300.0	344.1	10.1
Strata1	ReMeasurementYear2	LAOC	20.1	11.3	35.0	70.6	10.1	20.1	33.3	73.5	3.3
Strata1	ReMeasurementYear2	PICO	3.3	0.8	11.7	16.0	2.2	16.8	133.3	153.5	23.5
Strata1	ReMeasurementYear2	PIPO	17.6	33.0	31.5	81.5	18.1	17.6	125.0	160.1	5.0
Strata1	ReMeasurementYear2	PSME	6.0	4.9	21.0	29.6	4.5	34.1	300.0	340.1	14.1

Seedling and sapling density includes live and dead trees.

Question 3: By the second re-measurement which species of mature trees saw the greatest mortality?

2.4 **Close** the report.

2.5 Build the *Tree by Species* summary report again but this time set the **Strata by** field to "*(None)*".



Note that the tree species are listed for each macroplot and each monitoring status, not summarized to the stratum as they were in the previous report. This step is just to show how the reports look when macroplots are not stratified.

2.6 **Close** the report.

Exercise 3: Create Analysis Reports

The parametric analysis reports in FFI use an *F-Test* and *Dunnett's multiple comparison procedure with a control* to identify significant differences in report attributes. First, the F-test is used to note if there are any significant differences in the attribute means. If significant differences are noted with the F-test then FFI uses the Dunnett's procedure to determine which means significantly differ. In FFI the 'control' attribute used for the Dunnett's procedure is always the top-most monitoring status selected on the Included Monitoring Statuses tab (**1.9**). The statistical tests are made by comparing each subsequent monitoring status to the control. The p-value for each comparison is presented at the bottom of the report.

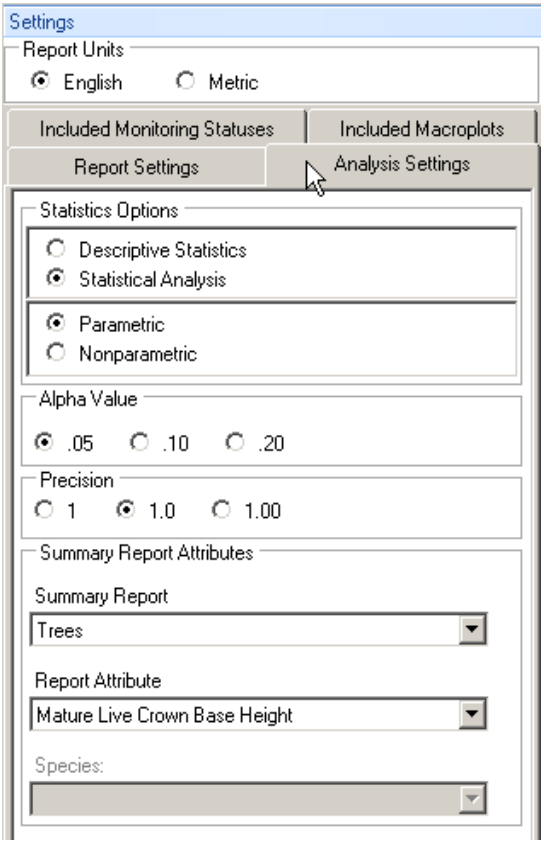
See the notes at the end of these exercises for more information about the statistical testing in FFI.

When data is not normally distributed, non-parametric equivalents of the F-test and Dunnett's procedure are also available. FFI uses *Friedman's chi-square*, *non-parametric multiple comparisons based on Friedman's Rank Sums* and a *distribution free confidence interval* for the non-parametric comparisons.

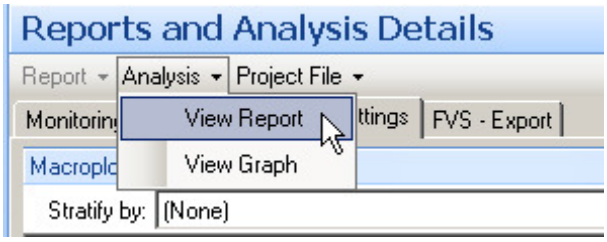
A minimum of four macroplots are required for parametric or non-parametric comparisons. Dunnett's comparison and Friedman's Rank Sums require data for each sample event. Any sample events with missing data can not be included in a test.

Mature Live Crown Base Height

3.1 If not already selected, click on the **Analysis Settings** tab on the right. Select: *Statistical Analysis*, *Parametric*, Alpha=*0.05*, Precision=*1.0*, Summary Report = *Trees*, Report Attribute = *Mature Live Crown Base Height*.



3.2 Click **Analysis** > **View Report**.



Project Unit_____**FOREST**
Summary Report_____**Trees**
Report Attribute_____**Mature Live Crown Base Height**
Units_____**Feet**

	PreTreatmentYear1	ReMeasurementYear1			ReMeasurementYear2		
	Plot	Attr	Attr	Diff	%Diff	Attr	Diff	%Diff
TESTFOREST1		27.2	51.7	24.5	90.0	51.7	24.5	90.0
TESTFOREST3		26.4	34.8	8.4	31.6	38.0	11.6	43.9
TESTFOREST4		24.8	33.0	8.2	33.1	31.0	6.2	25.0
TESTFOREST5		27.6	35.0	7.4	26.8	36.7	9.1	32.9
TESTFOREST6		27.6	32.8	5.2	19.0	29.5	2.0	7.1
TESTFOREST8		28.7	34.4	5.7	20.0	34.4	5.7	20.0
Mean		27.0	36.9			36.9		
SDev		1.3	7.3			7.9		
N		6.0	6.0			6.0		
CI-Lower		25.7	29.3			28.6		
CI-Upper		28.4	44.6			45.2		

F-Value = 4.98 Prob = 0.0220 Alpha =.05 (Settings Dialog Box)

PreTreatmentYear1 to ReMeasurementYear1: p <= .01
PreTreatmentYear1 to ReMeasurementYear2: .01 < p <= .05

Each analysis report includes a header that lists the Project being analyzed (Forest), the Summary Report being examined (Trees), the Report Attribute (Mature Live Crown Base Height) and the Units of the attribute (Feet).

Average Mature Live Crown Base Height (MLCBH) is calculated by averaging the *Live Crown Base Height* for every tree in the Trees-Individual protocol (Single Trees table), across all macroplots in the stratum, for each monitoring status. The result is shown in the row labeled 'Mean' in the analysis table.

Near the bottom of the analysis report you will see that the F-value calculated for this analysis was 4.98. The probability of this F-value is 0.0220. That probability is lower than the Alpha value set in **3.1** (0.05) and indicates there are significant differences in the attribute means. When the F-test is significant FFI then produces p-values for the Dunnett's comparison at the bottom of the report. In the example, the mean MLCBH for P1 (27.0 ft) is tested against R1 (36.9 ft) and then the mean MLCBH for P1 (27.0 ft) is tested against R2 (36.9 ft). The attribute means are considered significantly different if the p-value for the Dunnett's procedure is less than the significance level you choose (usually 0.01 or 0.05).

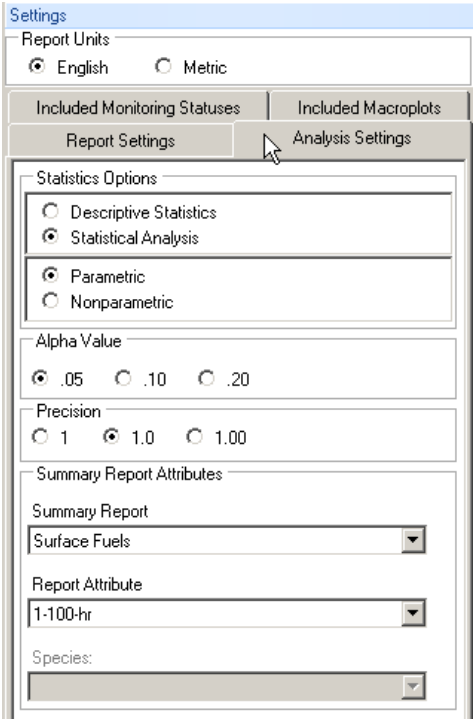
***Question 4*)** Were there any significant differences in Live Crown Base Height after the fire treatment at the 0.05 significance level?

Note that the mean MLCBH appears to be the same for R1 and R2 but the Dunnett's probability is different. If you run the same analysis report with precision set to *1.00* you'll see the means are different, which is why the probabilities for the Dunnett's comparisons are different.

3.3 **Close** the report

Biomass of Fine Woody Debris (FWD)

3.4 If not already selected, click on the **Analysis Settings** tab on the right. Select: *Statistical Analysis*, *Parametric*, Alpha=*0.05*, Precision=*1.0*, Summary Report = *Surface Fuels*, Report Attribute = *1-100 hr*



3.5 Click **Analysis** > **View report**

Project Unit_____**FOREST**
Summary Report_____**Surface Fuels**
Report Attribute_____**1-100-hr**
Units_____**Tons per Acre**

Strata: Strata1

Plot	P1 Attr	R1 Attr	Diff	%Diff	R2 Attr	Diff	%Diff
TESTFOREST1	11.4	6.0	-5.4	-47.1	8.2	-3.2	-28.5
TESTFOREST3	2.4	1.4	-1.0	-42.7	1.5	-0.8	-34.4
TESTFOREST4	5.9	1.4	-4.5	-76.6	2.2	-3.7	-62.3
TESTFOREST5	4.0	2.0	-1.9	-49.2	2.9	-1.1	-27.1
TESTFOREST6	3.0	1.4	-1.6	-53.4	1.6	-1.4	-47.3
TESTFOREST8	5.5	2.2	-3.2	-59.0	3.5	-2.0	-36.1
Mean	5.4	2.4			3.3		
SDev	3.3	1.8			2.5		
N	6.0	6.0			6.0		
CI-Lower	1.9	0.5			0.7		
CI-Upper	8.8	4.3			5.9		

F-Value = 2.03 Prob = 0.1659 Alpha =.05 (Settings Dialog Box)

Question 5: Did the treatment meet the general goal of reducing FWD (1-100hr) biomass?

3.6 **Close** the report.

Exercise 4.0: Use the Analysis Reports to view species specific reports

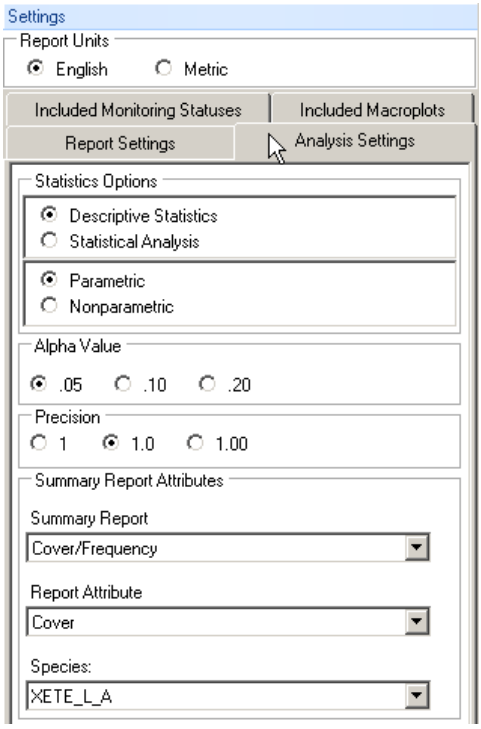
Cover of beargrass (XETE)

4.1 On the **Report Settings** tab select *Cover/Frequency*, stratify by *UV2* and click **Report** > **View Report** to view the Cover/Frequency summary.

You'll see it is difficult to compare the cover of XETE across monitoring status because of all the species in the Cover/Frequency Report. By using the Analysis Reports you can get view average cover for individual species more easily.

4.2 **Close** the report.

4.3 Click the **Analysis Settings** tab.
Select: *Descriptive statistics*, *Parametric*, Precision = *1.0*
Select Summary Report = *Cover/Frequency*, Report Attribute = *Cover*, Species = *XETE_L_A* (L=live and A=aerial cover). (When using descriptive statistics Alpha value is not used.)



4.4 Click **Analysis** > **View report**

Project Unit_____**FOREST**
Summary Report_____**Cover/Frequency**
Report Attribute_____**Cover**
Units_____**Percent**
Species_____**XETE_L_A**

Strata: Strata1

	PreTreatmentYear1	ReMeasurementYear1			ReMeasurementYear2		
Plot	Attr	Attr	Diff	%Diff	Attr	Diff	%Diff
TESTFOREST1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TESTFOREST3	24.8	15.2	-9.6	-38.7	20.0	-4.8	-19.4
TESTFOREST4	20.8	0.0	-20.8	-100.0	20.0	-0.8	-3.8
TESTFOREST5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TESTFOREST6	3.6	5.6	2.0	55.6	2.4	-1.2	-33.3
TESTFOREST8	5.6	0.0	-5.6	-100.0	5.6	0.0	0.0
Mean	9.1	3.5			8.0		
SDev	10.9	6.2			9.5		
N	6.0	6.0			6.0		
CI-Lower	-2.3	-3.0			-2.0		
CI-Upper	20.5	9.9			18.0		

You will see in the report header that the percent cover of XETE_L_A is the attribute being reported. XETE was found on four of the six macroplots in the project. Even though XETE was not seen at any sample event for two of the macroplots a cover value of zero is included in the report because it was seen on other macroplots. In FFI the cover of a species not seen on a macroplot is assumed to be zero if that species occurs on another macroplot in the same project, sampled with the same protocol.

Question 6: Was the general goal of maintaining XETE cover successful by the second re-measurement?

Question 7: Is there enough data to get statistical inference of XETE cover using the FFI analysis tools?

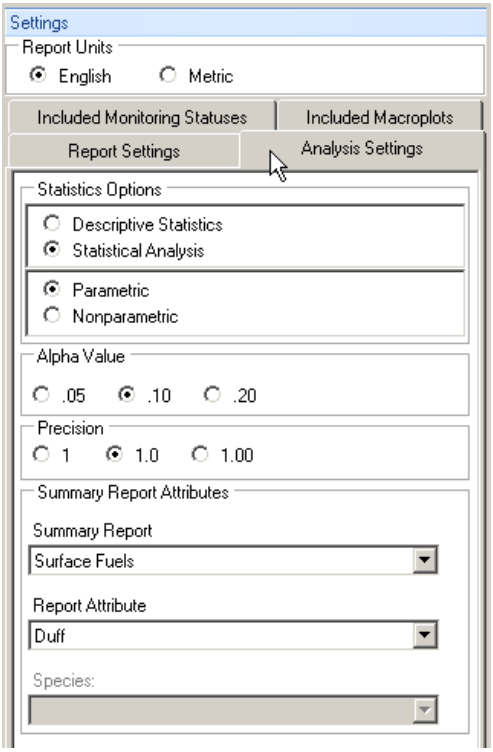
4.5 **Close** the report.

Exercise 5: Use the Confidence Intervals (CI) in lieu of One-sample t-tests

In some cases a treatment will be applied in the hope an attribute will meet some target value. The FFI confidence intervals in the analysis reports can be used to make these inferences.

Biomass of Duff

5.1 If not already selected, click on the **Analysis Settings** tab.
Select: *Statistical Analysis*, *Parametric*, Alpha = *0.10*, Precision = *1.0,*
Summary Report = *Surface Fuels*, Report Attribute = *Duff*.



5.2 Make sure *UV2* is selected in the **Strata by** field, then click **Analysis** > **View Report**

Project Unit_____**FOREST**
Summary Report_____**Surface Fuels**
Report Attribute_____**Duff**
Units_____**Tons per Acre**

Strata: Strata1

Plot	P1 Attr	R1 Attr	Diff	%Diff	R2 Attr	Diff	%Diff
TESTFOREST1	15.8	10.7	-5.1	-32.3	13.0	-2.9	-18.1
TESTFOREST3	8.5	6.9	-1.5	-18.2	7.9	-0.6	-7.4
TESTFOREST4	16.8	12.5	-4.4	-25.9	11.6	-5.3	-31.4
TESTFOREST5	11.5	10.9	-0.6	-5.4	10.8	-0.7	-6.3
TESTFOREST6	9.3	6.1	-3.2	-34.2	8.1	-1.3	-13.7
TESTFOREST8	18.4	8.6	-9.8	-53.3	11.7	-6.7	-36.5
Mean	13.4	9.3			10.5		
SDev	4.2	2.5			2.1		
N	6.0	6.0			6.0		
CI-Lower	10.0	7.3			8.8		
CI-Upper	16.8	11.3			12.2		

F-Value = 2.88 Prob = 0.0872 Alpha =.10 (Settings Dialog Box)

P1 to R1: .01 < p <= .05
P1 to R2: p > .05

The FFI analysis report includes two confidence interval values for each sample event: CI-Upper and CI-Lower. When a target value is greater than CI-Lower and less than CI-Upper it can be interpreted that you are 95% certain the target was met*. For example, the target of 11 tons/acre of duff was seen in the pretreatment sampling because it is great than 10.0 (CI-Lower) and less than 16.8 (CI-Upper).

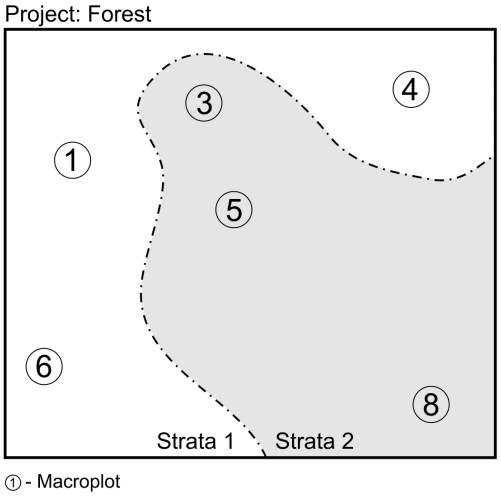
*This interpretation is common and useful but not technically correct. The technical definition of a confidence interval states if a large number of samples were taken and confidence intervals for were constructed for each then theoretically about 95% of the intervals would include the population mean.

Question 8: Was the general goal of maintaining 11.0 tons/per acre of duff after the fire treatment met at the time of the second re-measurement?

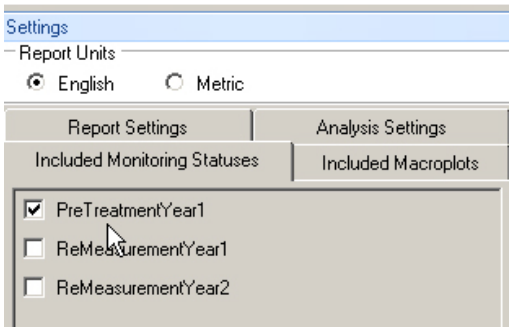
Question 9: Note that in this example Alpha=0.10. Would there have been a significant difference in the mean duff biomass between treatments if it had been set to 0.05?

Exercise 6: Stratify data using the UV fields on the Macroplot form

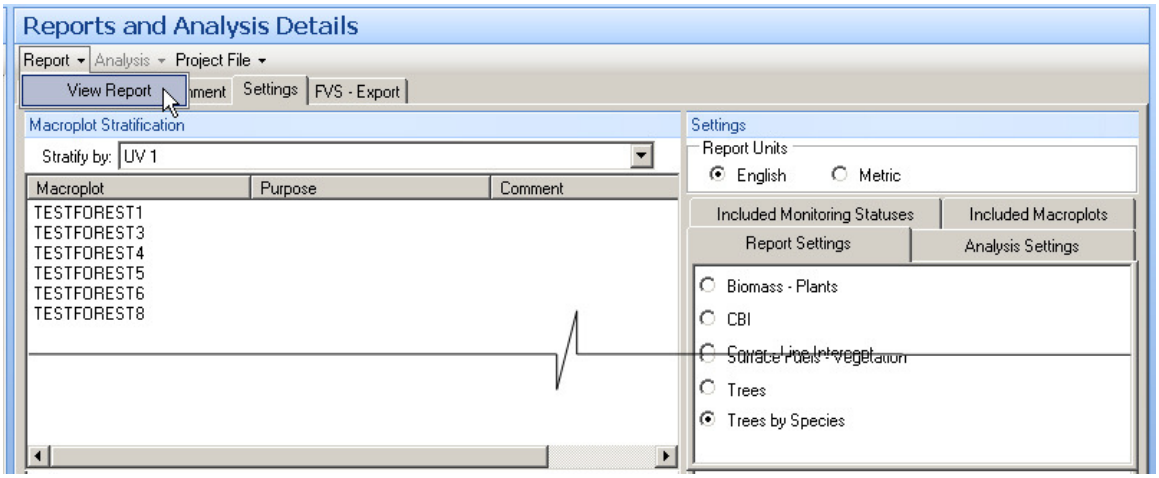
The User Variable fields on the Macroplot form (under Project Management) allow plots in a project to be divided into groups for reports and analysis. For instance, plots could be stratified by cover type, ownership, fire behavior fuel model, etc. In this example, assume the project was stratified from pretreatment aerial photos and a windshield survey that noted a change in structure between Strata 1 and Strata 2. These strata are stored for each macroplot in the *UV1* field on the **Project Management > Macroplot > User Variables** tab.



6.1 We are only interested in the pretreatment stand structure for this example so click on the **Included Monitoring Statuses** tab and uncheck *ReMeasureYear1* and *ReMeasureYear2.* This will simplify the report by reporting only the first Monitoring Status.



6.2 Click on the **Report Settings** tab and select the *Tree by Species* report at the bottom, set **Strata by** to *UV1*, and click **Report > View Report**.



Trees by Species Strata Summary

Strata	Monitoring Status	Species	Trees (per acre)	Basal Area (sq. ft. / acre)	Avg. Live Crown Base Height (ft.)	Avg. Height (ft.)	QMD (in)	Saplings (per acre)	Seedlings (per acre)	Total Trees (per acre)
			Mature Trees							
Strata1	PreTreatmentYear1	LAOC	20.0	9.9	27.0	65.5	9.5	20.0	100.0	140.0
Strata1	PreTreatmentYear1	PICO	30.0	7.3	23.3	48.3	6.7	0.0	0.0	30.0
Strata1	PreTreatmentYear1	PIPO	20.2	25.7	27.2	85.2	16.5	15.1	100.0	135.3
Strata1	PreTreatmentYear1	PSME	20.1	17.8	27.5	69.0	12.7	40.1	300.0	360.2
Strata2	PreTreatmentYear1	LAOC	20.1	12.0	31.0	72.9	10.4	20.2	0.0	40.3
Strata2	PreTreatmentYear1	PICO	20.1	4.8	25.9	46.1	6.5	25.2	100.0	145.3
Strata2	PreTreatmentYear1	PIPO	20.0	35.7	26.2	68.5	16.5	20.0	150.0	190.0
Strata2	PreTreatmentYear1	PSME	10.0	4.0	12.5	27.0	4.3	25.0	400.0	435.0

The report shows attributes listed for each species and divided into the two strata. In the training data we simply call these Strata 1 and Strata 2. In your projects you will want to use names that are more descriptive like the treatment unit number, or North and South to differentiate plots on different aspects. You can name them pretty much anything you like.

Question 10: Look at the trees per acre, height and QMD for species in each stratum**.** Which tree species is likely the cause of the stand structure differences between Strata 1 and Strata 2 that were noted from the aerial photos and drive through survey?

More information about the statistical tests in FFI and testing re-sampled macroplots

In FFI we use an F-test, which assumes a *Random Block Design* - in other words it assumes the macroplots are randomly distributed in the treatment at *every* sampling visit. In most cases the U.S. land management agencies do not follow this practice; instead, macroplots are randomly distributed and permanently established at the first sampling visit, then crews return to the same locations for re-sampling. When re-sampling permanently established plots a test called a *Difference of Means Test* is more appropriate (as long as the assumptions of parametric tests are met). However, we do not provide difference of means tests in FFI at this time. When attributes from permanent plots are tested with the F-Test and Dunnett's Comparison Procedure the result is a more conservative (less prone to error) result than the Difference of Means test.

We can demonstrate using the Training Dataset. The tests use the 1-100 hour Surface Fuels and compare the F-Test results from FFI (the same test we did in Exercise **3.5**) with a Difference of Means T-test from a statistics package.

F-Test Results from FFI:

H_0: P1 = R1
H_1: P1 <> R1
If $p(F)>\alpha$ then no evidence that P1<>R1
0.1659>0.05; indicating the biomass of 1-100 hour fuels is not significantly different between PretreatmentYear1 and RemeasurementYear1

Project Unit_____FOREST
Summary Report_____Surface Fuels
Report Attribute_____1-100-hr
Units_____Tons per Acre

PreTreatmentYear1 Plot	Attr	ReMeasurementYear1 Attr	Diff
TESTFOREST1	11.4	6.0	-5.4
TESTFOREST3	2.4	1.4	-1.0
TESTFOREST4	5.9	1.4	-4.5
TESTFOREST5	4.0	2.0	-1.9
TESTFOREST6	3.0	1.4	-1.6
TESTFOREST8	5.5	2.2	-3.2
Mean	5.4	2.4	
SD	3.3	1.8	

F-Value = 2.03 Prob = **0.1659** Alpha = **0.05** (Settings Dialog Box)

Difference if Means Test Results from JMP

H_0: P1 – R1= 0
H_1: P1 – R1 <> 0
If *p(F)*<α then there is evidence that P1 – R1 <> 0
0.0086<0.05 indicating the difference of 1-100 hour fuels between PretreatmentYear1 and RemeasurementYear1 is significantly different than 0. Because the mean is negative we can assume there is a significant reduction in 1-100 hour fuels after treatment.

PreTreatmentYear1 Plot	PreTreatmentYear1 Attr	ReMeasurementYear1 Attr	Diff
TESTFOREST1	11.4	6.0	-5.4
TESTFOREST3	2.4	1.4	-1.0
TESTFOREST4	5.9	1.4	-4.5
TESTFOREST5	4.0	2.0	-1.9
TESTFOREST6	3.0	1.4	-1.6
TESTFOREST8	5.5	2.2	-3.2
Mean			-2.97
SD			1.73

T-Value = 4.19 Prob = **0.0086** Alpha = **0.05**

No significant difference was noted in the Dunnett's test used by FFI but there was a difference noted when using a more sensitive Difference of Means Test. In most cases like this it would be appropriate to say there was a significant difference in 1-100 hour biomass – or whatever attribute was being tested - between *PretreatmentYear1* and *RemeasurementYear1*. When using the Difference of Means test and comparing more than two pairs of data a Bonferroni Adjustment can be made to guard against Type I error.